

atmosphere was equilibrated, and another round of measurements were made. The procedure was repeated until the samples were measured in all of the desired atmospheres at a particular temperature. At this point
5 the temperature was changed and the process repeated. After all of the measurements had been made the furnace was cooled to room temperature and the samples removed.

For the sensor array chips, a measurement system similar to that described above can be used. The only
10 difference is that the platinum wires, which are connected to the inconel wires in the furnace, must be connected to the electrode pads on the array chip using a conducting paste (Pelco product #16023). The number of connections from the sample to the switch depends on
15 the number of sensors on the array.

Example 1

This example shows the change in the electrical properties of 20 metal oxide semiconducting materials in the presence of 4 combustion gas compositions at
20 450°C. The signals listed in Table 1 below are from the infrared thermographic technique described above. The signals represent differences in temperature (°C) of the materials when exposed to one of the 4 gas compositions shown relative to that in a comparison gas
25 which is 2% O₂/ 98% N₂ and reflect the change in the electrical resistance of the semiconducting materials. All of the signals were generated with 10 V across the materials, unless otherwise specified. Blank spaces indicate that there was no detectable signal when that
30 gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N₂.

Table 1
Change in temperature in °C

	ZnO	SnO ₂	NiFe ₂ O ₄	WO ₃	1% Nb:TiO ₂	Pr ₆ O ₁₁	SrNb ₂ O ₆
NO ₂ in N ₂	-38.1	-35.4	-27.4	-16.4	-2.7	-5.6	-2.8
NO ₂ in 2%	-35.2	-32.5	-13.7	-13.5	-2.7	-	-

O ₂ / 98% N ₂							
CO in N ₂	27.2	8.2	14	13.7	-	-	8.3
N ₂ ref.	16.9	9.6	11.2	5.6	12.4	-	-

	NiO	CuO	Cu ₂ O	MnTiO ₃	BaCuO _{2.5}	AlVO ₄	CuMnFeO ₄
NO ₂ in N ₂	5.5	8.2	8.2	5.6	6.6	-	-
NO ₂ in 2% O ₂ / 98% N ₂	5.5	5.6	5.5	-	2.6	-2.7	2.6
CO in N ₂	-	-5.5	-13.8	-	-2.7	11.3	-
N ₂ ref.	-2.8	-5.6	-2.8	-	-2.7	8.3	-

	LaFeO ₃	CuGaO ₂	CuFe ₂ O ₄	Zn ₄ TiO ₆	La ₂ CuO ₄	SrCu ₂ O ₂
NO ₂ in N ₂	-	-2.8	-5.5	-5.7	4.2	-
NO ₂ in 2% O ₂ / 98% N ₂	-	-	-2.5	-	-	2.6
CO in N ₂	-2.8	-	-	7.3	-	-
N ₂ ref.	-	-	-	-	-	-

- 5 The following measurements were done with other than 10 V. Pr₆O₁₁ was measured using 1 V; BaCuO_{2.5}, CuMnFeO₄, CuGaO₂ and CuFe₂O₄ were measured using 16 V; Zn₄TiO₆ was measured using 20 V; LaCuO₄ and SrCu₂O₂ were measured using 12 V.

10 Example 2

- This example shows the change in the electrical properties of 8 metal oxide semiconducting materials in the presence of 5 combustion gas compositions at 450°C. The signals listed in Table 2 below are from the
- 15 infrared thermographic technique. The signals are differences in temperature (°C) of the semiconducting materials when exposed to the gas compositions shown relative to that in a comparison gas which is 2% O₂/ 98% N₂. All of the signals were generated with 10 V
- 20 across the semiconducting materials, unless otherwise specified. Blank spaces indicate that there was no detectable signal when that gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N₂.

25

Table 2

Change in temperature in °C

	ZnO	SnO ₂	WO ₃	SrNb ₂ O ₆	NiO	CuO	Cu ₂ O	AlVO ₄
NO ₂ in N ₂	-38.1	-35.4	-16.4	-2.8	5.5	8.2	8.2	-
NO ₂ in 2% O ₂ / 98% N ₂	-35.2	-32.5	-13.5	-	5.5	5.6	5.5	-2.7
CO in N ₂	27.2	8.2	13.7	8.3		-5.5	-13.8	11.3
N ₂ ref.	16.9	9.6	5.6	-	-2.8	-5.6	-2.8	8.3
1% C ₄ H ₁₀ / 99% N ₂	38	28	22	-	-6	-7	-11	11

Example 3

- 5 This example shows the change in the electrical properties of 26 metal oxide semiconducting materials in the presence of 4 combustion gas compositions at 600°C. The signals listed in Table 3 immediately below were obtained using an infrared thermographic
- 10 technique. The signals are measurements of the differences in temperature (°C) of the materials when exposed to the gas compositions shown relative to that in a comparison gas which is 2% O₂/ 98% N₂. All of the signals were generated with 10 V across the materials,
- 15 unless otherwise specified. Blank spaces indicate that there was no detectable signal when that gas composition was contacted with that material. Unless otherwise specified, the gases were measured at 2000 ppm in N₂.

20

Table 3
Change in temperature in °C

	ZnO	SnO ₂	NiFe ₂ O ₄	1% Nb:TiO ₂	WO ₃	FeTiO ₃	SrTiO ₃	NiO
NO ₂ in N ₂	-54.4	-48.3	-36.3	-24.2	-18.1	-6.1	3	6
NO ₂ in 2% O ₂ / 98% N ₂	-48.3	-48.3	-30.2	-12.1	-18.1	-6.1	6	6
CO in N ₂	28.5	18.1	18.5	42.3	24.1	-	-	-6
N ₂	30.2	24.1	15.1	24.1	6	3	-	-9.1

	AlVO ₄	CuO	Cu ₂ O	LaFeO ₃	BaCuO _{2.5}	Fe ₂ O ₃	SrNb ₂ O ₆	ZnO + 2.5% F2889
--	-------------------	-----	-------------------	--------------------	----------------------	--------------------------------	----------------------------------	------------------